

REMARKS

Favorable reconsideration of this application is requested in view of the above amendments and in light of the following remarks and discussion.

Claims 1-7 are pending in the application. Independent claim 1 is amended. Support for the changes to the claims is self-evident from the originally filed disclosure, including the original claims, and therefore no new matter is added.

In the Office Action claims 1-7 are rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,692,249 to Beatty et al. (Beatty). It is requested that the rejection of the claims be withdrawn, and that the claims be allowed, for the following reasons.

The present invention, as set forth in independent claim 1, is directed to an outer tube configured to be used in a thermal treatment system. The tube is made of silicon carbide, and has an upper portion closed and a lower portion opened. The lower portion is formed with a tapered portion so as to expand a diameter thereof toward a lower end thereof. A flange is formed on an outer peripheral side of the lower portion. The following conditions are met in the outer tube:

- 1) a ratio of t_a/D_1 is from 0.0067 to 0.025,
- 2) a product of $t_a \times D_1$ is from 600 to 4,000 (mm^2),
- 3) $(D_{F2}-D_{F1}) \times t_c / (D_1 \times t_a)$ is from 0.1 to 0.7, and
- 4) L_1/L_2 is from 1 to 10;

where the outer tube has a thickness of t_a (mm) and an inner diameter of D_1 (mm), the flange has a thickness of t_c (mm), an inner diameter of D_{F1} (mm) and an outer diameter of D_{F2} (mm), and the tapered portion has a height L_1 (mm) and an expanse of L_2 (mm).

The Office Action concedes, on page 2, lines 18-20 of text, that Beatty does not disclose the claimed relationships among the outer tube thickness, outer tube inner diameter, flange thickness, flange inner and outer diameters, and tapered portion height and expanse.

The Office Action asserts, however, beginning on page 2, line 21 of text, that

[t]he optimization of the dimensions of an apparatus is a fundamental engineering skill and is part of applying the disclosure of patents, which rarely give specific dimensions. Furthermore, it was held in *Gardner v. TEC Systems, Inc.*, 725 F.2d 1338, 220 USPQ 777 (Fed. Cir. 1984), cert. denied, 469 U.S. 830, 225 USPQ 232 (1984), by the Federal Circuit that, where the only difference between the prior art and the claims was a recitation of relative dimensions of the claimed device and a device having the claimed relative dimensions would not perform differently than the prior art device, the claimed device was not patentably distinct from the prior art device.

In this case, it is submitted that the entirety of Applicants' originally filed disclosure is directed to why the claimed device would and does perform differently than the prior art device, and therefore the reliance on *Gardner* is improper and the rejection must be withdrawn.

For example, from page 2, line 7 to page 4, line 17, of the specification details specific problems with the known, prior art outer tube, which are avoided by the claimed outer tube, which is discussed from page 5, line 17 to page 17, line 23. More specifically, Applicants' determined, through stress analysis and other methods of analysis, the relationships among outer tube thickness, outer tube inner diameter, flange thickness, flange inner and outer diameters, and tapered portion height and expanse, and stresses generated throughout the outer tube.

In particular, Applicants determined that when a ratio of t_a/D_1 (outer tube thickness, outer tube inner diameter) is lower than 0.0067, it is surmised that a problem is caused in terms of mechanical strength. When the ratio of t_a/D_1 is higher than 0.025, it is surmised that the amount of thermal transfer becomes excessive and the flange is subjected to a great stress.

See page 7, lines 15-22, of Applicants' originally filed specification. Thus, independent claim 1 recites that the ratio of t_a/D_1 is from 0.0067 to 0.025.

Applicants further determined that when the product of $t_a \times D_1$ (outer tube thickness, outer tube inner diameter) is lower than 600 (mm^2), it is surmised that a problem is caused in terms of mechanical strength. When the product of $t_a \times D_1$ is higher than 4,000 (mm^2), it is surmised that the amount of thermal transfer becomes excessive. See from page 7, line 23 to page 8, line 2, of the specification. Thus independent claim 1 recites that the product of $t_a \times D_1$ is from 600 to 4,000 (mm^2).

Applicants still further determined that because the flange is normally cooled from the outer peripheral side thereof, thermal stresses are generated because of a temperature difference between the inner and outer peripheral sides thereof. The thermal stresses become greater as a ratio of $(D_{F2}-D_{F1})/D_1$ (flange outer diameter, flange inner diameter, and outer tube inner diameter) becomes greater. Based on Applicants' comparison between simulation and actual products, it is surmised that when $(D_{F2}-D_{F1}) \times t_c / (D_1 \times t_a)$ exceeds 0.7 (t_c indicating flange thickness, and t_a indicating outer tube thickness), the outer tube is broken by the thermal stresses. Conversely, when the value is lower than 0.1, it is surmised that mechanical strength is insufficient. See from page 8, line 15 to page 9, line 8, of the original specification. Thus, independent claim 1 recites that $(D_{F2}-D_{F1}) \times t_c / (D_1 \times t_a)$ is from 0.1 to 0.7.

Still further, Applicants determined that thermal stresses are decreased in the outer tube when the tapered portion is provided at the lower end of the outer tube so as to expand the inner diameter of the outer tube, as the expanded inner diameter increases the effective length required for thermal conduction and therefore decreases the temperature gradient. The gradient of the tapered portion is represented by the ratio of L_1/L_2 (tapered portion height to tapered portion expanse). See from page 9, line 23 to page 10, line 9, of the specification. Thus, independent claim 1 recites that L_1/L_2 is from 1 to 10.

It is submitted that the foregoing provides sufficient grounds indicating that the outer tube in accordance with the present invention, including the claimed relationships among the outer tube thickness, outer tube inner diameter, flange thickness, flange inner and outer diameters, and tapered portion height and expanse, would perform differently than a known, prior art tube, such as the tube in Beatty. Specifically, the claimed outer tube avoids the problems of breakage due to thermal stress in the known tube, and has a greater strength than the known tube.

It is further submitted that in accordance with MPEP § 2144.05(B.), because Beatty does not recognize that any of the claimed relationships among the outer tube thickness, outer tube inner diameter, flange thickness, flange inner and outer diameters, and tapered portion height and expanse of the outer tube achieve any recognized result, a determination of workable or optimum ranges for any of these claimed relationships cannot be characterized as routine experimentation.

For these reasons, it is requested that the rejection of independent claim 1 be withdrawn, and that independent claim 1 be allowed.

Notwithstanding the above discussion, which Applicants' assert provides adequate grounds for the allowance of independent claim 1, Applicants' disclosure proves that the claimed outer tube does, in fact, perform differently than the known, prior art outer tube.

From page 13, line 16 to page 17, line 2, of the originally filed specification, two examples (examples 1 and 2) of outer tubes produced in accordance with the claimed invention are compared to two known, prior art outer tubes (comparative examples 3 and 4).

Briefly, Applicants experimentally proved, in example 1, that the outer tube prepared in accordance with the invention having the following conditions was not cracked during use in conditions that would crack the known, prior art outer tube: $t_a/D_1=0.0081$; $t_a \times D_1=768$ (mm²); $(D_{F2}-D_{F1}) \times t_c / (D_1 \times t_a)=0.39$; and $L_1/L_2=4.3$. See from page 13, line 20 to page 14, line

16, of the specification. These conditions are within the claimed recitations of a ratio of t_a/D_1 from 0.0067 to 0.025, a product of $t_a \times D_1$ from 600 to 4,000 (mm^2), $(D_{F2}-D_{F1}) \times t_c / (D_1 \times t_a)$ from 0.1 to 0.7, and L_1/L_2 from 1 to 10, as recited in independent claim 1.

Applicants also experimentally proved, in example 2, that the outer tube prepared in accordance with the invention having the following conditions was not cracked during use in conditions that would crack the known, prior art outer tube: $t_a/D_1=0.015$; $t_a \times D_1=1,382$ (mm^2); $(D_{F2}-D_{F1}) \times t_c / (D_1 \times t_a)=0.21$; and $L_1/L_2=4.3$. See from page 14, line 17 to page 15, line 17, of the specification. Again, it is submitted that these conditions are within the claimed recitations of a ratio of t_a/D_1 from 0.0067 to 0.025, a product of $t_a \times D_1$ from 600 to 4,000 (mm^2), $(D_{F2}-D_{F1}) \times t_c / (D_1 \times t_a)$ from 0.1 to 0.7, and L_1/L_2 from 1 to 10, as recited in independent claim 1.

Conversely, Applicants experimentally proved, in comparative example 3, that the known, prior art outer tube in which $(D_{F2}-D_{F1}) \times t_c / (D_1 \times t_a)=0.87$ cracks during use in conditions that do not crack the outer tube prepared in accordance with the claimed invention. See from page 15, line 18 to page 16, line 11, of the specification. Similarly, Applicants experimentally proved, in comparative example 4, that that the known, prior art outer tube in which $t_a/D_1=0.0065$ and $(D_{F2}-D_{F1}) \times t_c / (D_1 \times t_a)=1.66$ cracks during use in conditions that do not crack the outer tube prepared in accordance with the claimed invention. See from page 16, line 12 to page 17, line 2, of the specification.

For these reasons, it is submitted that the claimed relationships among the outer tube thickness, outer tube inner diameter, flange thickness, flange inner and outer diameters, and tapered portion height and expanse result in an outer tube that would and does perform differently than the known, prior art tube. It is therefore submitted that the claimed outer tube is patentably distinct from the tube of Beatty.

Thus, it is submitted that the foregoing provides further grounds for the allowance of independent claim 1.

Independent claim 4 is allowable for reasons similar to those discussed above with respect to independent claim 1. For these reasons, it is requested that the rejection of independent claim 4 be withdrawn, and that independent claim 4 be allowed.


The remaining claims are allowable for the same reasons as independent claims 1 and 4 from which they depend, as well as their own features, particularly in combination with the features of the independent claims. The allowance of dependent claims 2, 3 and 5-7 is therefore requested.

Consequently, for the reasons discussed in detail above, no further issues are believed to be outstanding in the present application, and the present application is believed to be in condition for formal allowance. Therefore, a Notice of Allowance is earnestly solicited.

Should the Examiner deem that any further action is necessary to place this application in even better form for allowance, the Examiner is encouraged to contact the undersigned representative at the below listed telephone number.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,
MAIER & NEUSTADT, P.C.

A handwritten signature in black ink, appearing to read 'Philip J. Hoffmann', is written over a horizontal line.

Gregory J. Maier
Attorney of Record
Registration No. 25,599

Customer Number
22850

Tel: (703) 413-3000
Fax: (703) 413 -2220
(OSMMN 06/04)

Philip J. Hoffmann
Registration No. 46,340